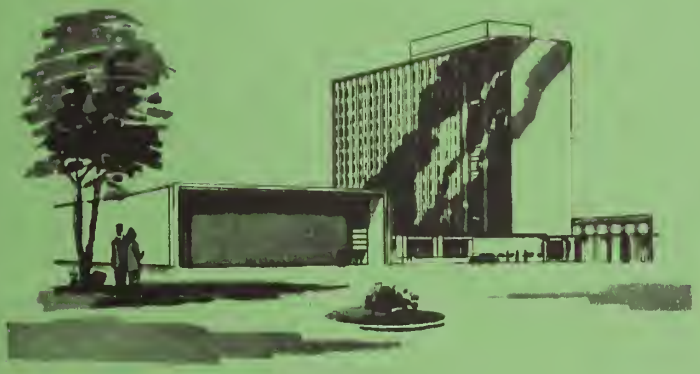
NBSIR 78-1327

INTERLABORATORY PROGRAMS FOR RUBBER

ANALYSES NO. 34

OCTOBER - DECEMBER 1977



U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

NBS COLLABORATIVE REFERENCE PROGRAMS

TAPPI Paper and Board (6 times per year)

- Bursting strength
- Tearing strength
- Tensile breaking strength
- Elongation to break
- Tensile energy absorption
- Folding endurance
- Stiffness
- Air resistance
- Grammage
- Smoothness
- Surface pick strength
- K & N ink absorption
- pH
- Opacity
- Blue reflectance (brightness)
- Specular gloss, 75°
- Thickness
- Concora (flat crush)
- Ring crush

FKBG-API Containerboard (48 times per year)

- Mullen burst of linerboard
- Concora test of medium

MCCA Color and Appearance (4 times per year)

- Gloss at 60°
- Color and color difference
- Retroreflectivity

Rubber (4 times per year)

- Tensile strength, ultimate elongation and tensile stress
- Hardness
- Mooney viscosity
- Vulcanization properties

ASTM Textiles (3 times per year)

- Flammability (FF3-71 and FF5-74)

ASTM Cement (2 times per year)

- Chemical (11 chemical components)
- Physical (8 characteristics)

AASHTO Bituminous

- Asphalt cement (2 times per year)
- Cutbacks (once a year)

Collaborative Reference Programs
B360 Polymer Building
National Bureau of Standards
Washington, D.C. 20234

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INTERLABORATORY PROGRAMS FOR RUBBER

Analyses No. 34
October - December 1977

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U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards

NBSIR 78-1327

INTRODUCTION

This report summarizes the test results for the fourth quarter of 1977. The tests cover the four areas in the NBS Collaborative Reference Programs for Rubber: Tensile Properties, Hardness, Mooney Viscosity, and Vulcanization Properties.

For each of the four areas, there is a set of summary tables followed by a table of data and analysis by laboratory and a graphical presentation of the data and analysis. Where applicable, the tables of data have the English and Metric expressions side-by-side. Additional details are given in the section "Key to Tables and Graphs."

If there are questions or comments on the notes, the analyses, or the reports in general, contact Edwin B. Randall, Jr., Jeffrey Horlick, or Jeffrey Stevenson, (301) 921-2946.

Edwin B. Randall, Jr., Administrator
NBS Collaborative Reference Programs
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January 13, 1978

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KEY TO TABLES AND GRAPHS

LAB CODE — Confidential laboratory identification number known only to the participant and the Collaborative Reference Program staff.

F — A flag identifying results that are extreme in comparison with the other results.

- X - The plotted point for the indicated laboratory lies outside of the 99% error ellipse (not shown); ie, assuming normal distribution, 99% of laboratories similar to those participating in the program will be represented by points lying within the 99% ellipse.
- * - The plotted point for the indicated laboratory lies outside of the 95% error ellipse shown on graphs, but inside the 99% ellipse.

MEAN — The arithmetic average of the two median values for the two sheets or samples of the same material.

% DEV — The deviation or difference of the laboratory MEAN from the GR. MEAN (see below), expressed as a percent of the GR. MEAN.

REL SDR — The ratio of the SDR (standard deviation of replicate measurements within a laboratory) to the AVER SDR (see below). Extreme values, ie, values that are likely to occur by chance less than one time in a hundred as determined by the chi-square test, are marked with an "X".

VAR CODE — A code number designating a particular test instrument, set of environmental conditons, procedure, unit used, or other variation. The code "01" designates the instrument, conditions and procedure specified at the top of the page either explicitly or in the cited ASTM Standard, and the unit of test shown at the top of the first column of data. A '+' in front of the VAR CODE indicates that the data has been excluded from the grand means due to a non-standard variation of the possibilities mentioned above, or the data is extreme.

GR MEAN — The arithmetic average (grand mean) of all the laboratory MEAN values, excluding those flagged (F) with an "X".

SD MEANS — The standard deviation among the laboratory MEAN values included in the GR. MEAN.

AVER SDR The arithmetic average of all the standard deviations of within laboratory replication, excluding those excluded from the GR. MEAN and excluding any additional ones for which the REL SDR has been flagged.

GRAPH

For each laboratory the MEAN for the second material is plotted against the MEAN for the first material, with each point representing a laboratory. The horizontal and vertical lines are the GR. MEAN values. The dashed line is drawn at 45°. The solid sloping line, which may or may not lie close to the 45° line, is the major axis of the ellipse. The ellipse is drawn so that, on the average, it will include 95% of the points representing the laboratories. The plotted symbols X and * used to represent results falling outside the ellipse are explained under "F" above. Laboratories inside the ellipse (no flag in the F column) are plotted as an O.

The graph is plotted with an ellipse when there are 20 or more laboratories in the analysis. When there are 10 through 19 laboratories in the analysis, the graph is plotted but the ellipse is omitted. When there are fewer than 10 laboratories retained in the Grand Mean the graph is not plotted.

For development of the theory, see the paper by J. Mandel and T.W. Lashof, Interpretation and Generalization of Youden's Two-Sample Diagram, J. of Quality Technology, Vol. 6, pp 22-36, Jan. 1974.

SUMMARY OF ANALYSES

LABS INCL Number of laboratories included in the GR. MEANs.

LABS OMIT Number of laboratories reporting data but excluded from the GR. MEANs.

STANDARD DEVIATIONS

LABS Same as the SD MEANs (see above)

SHEETS Standard deviation between the two sheets or samples of the same material.

REPL Same as AVER SDR (see above)

PRECISION OF METHODS

REPL CRP The number of replicate measurements per sheet or sample, as specified in the Collaborative Reference Program.

REPL ASTM The number of replicate measurements specified for a test result in the designated ASTM Standard.

REPEAT The repeatability, a measure of the within laboratory precision, i.e., of the ability of the test technician to repeat his test result: two test results obtained by the same technician on the same homogeneous sample of material may be expected 95% of the time to agree within the repeatability.

REPROD The reproducibility, a measure of the between laboratory precision: two test results obtained in different laboratories may be expected 95% of the time to agree within the reproducibility.

ABSOLUTE Values of REPEAT and REPROD expressed in the units of measurement.

PERCENT Values of REPEAT and REPROD expressed as a percent of the GR. MEANs.

TENSILE STRENGTH, ULTIMATE ELONGATION, AND STRESS AT 300% ELONGATION

NOTES

Materials D71 and D72 were sheets of the same vulcanized rubber. Similarly, materials D73 and D74 were alike.

V100 results were obtained at NBS using a pendulum tester, V200 results were obtained at NBS using an electronic tester.

All participants used Die C in ASTM D412 with the following exceptions:

V126 used Die 2 in BS903
V148, V208 did not specify a Die
V225 used ASTM Die D

Electronic testers were used by 39 (64%) of the 61 participants; pendulum testers were used by 22 participants. Elongation measurements were made by automatic devices by 21 (34%) participants and manually by the rest. There were 9 (15%) reported relative humidities above 55% and 16 (26%) reported relative humidities below 45%.

SUMMARY OF ANALYSES

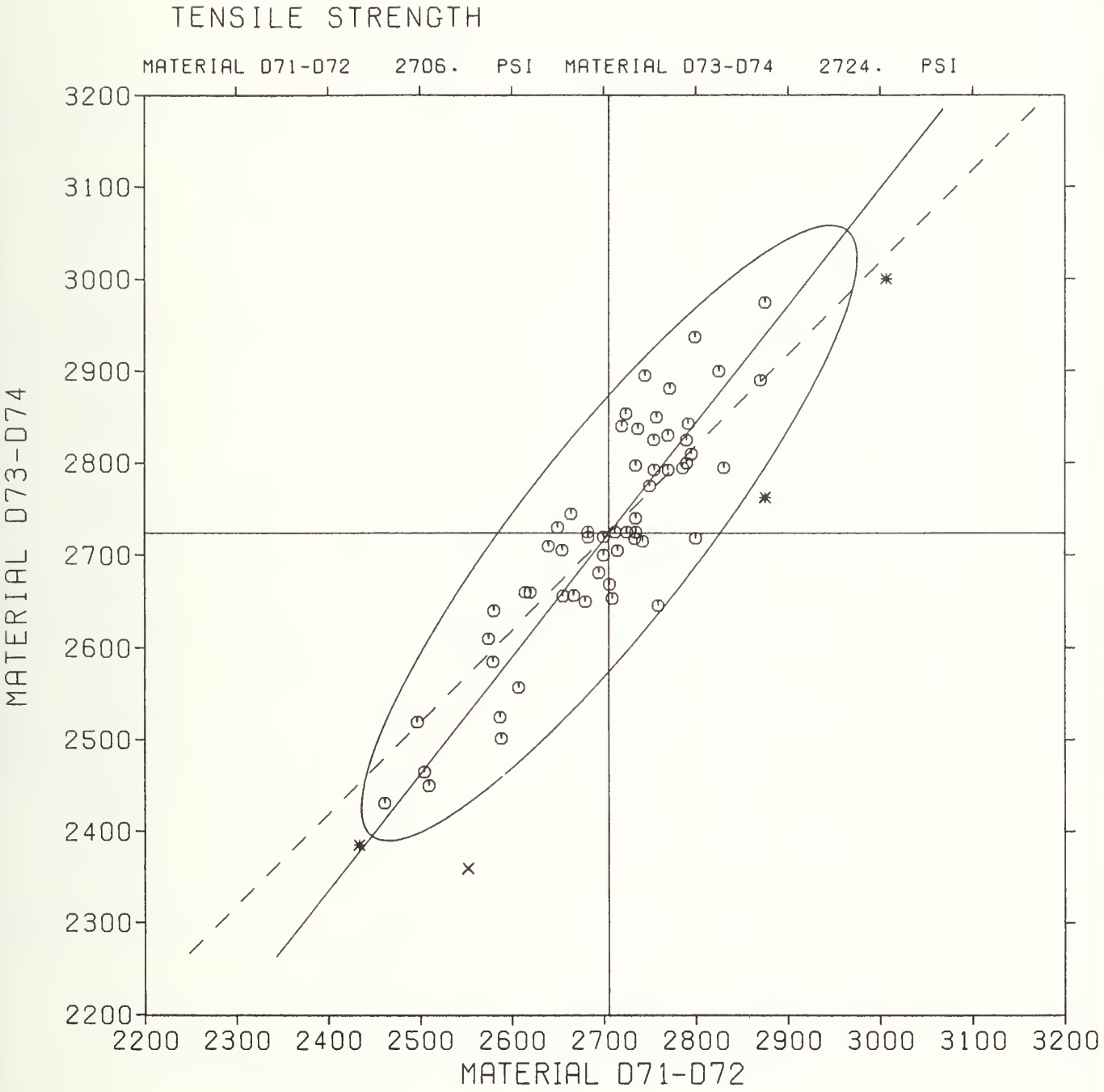
PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR.MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
TENSILE STRENGTH	D71-D72	60	1	2706.	106.	41.	66.	POUNDS PER SQUARE INCH
	D73-D74	60	1	2724.	132.	67.	62.	POUNDS PER SQUARE INCH
TENSILE STRENGTH	D71-D72	60	1	18.66	.73	.26	.46	MEGAPASCALS
	D73-D74	60	1	18.79	.91	.46	.43	MEGAPASCALS
ULTIMATE ELONGATION	D71-D72	59	2	672.	20.	9.	16.	PERCENT
	D73-D74	59	2	678.	22.	7.	14.	PERCENT
STRESS AT 300% ELONGATION	D71-D72	60	1	983.	47.	17.	23.	POUNDS PER SQUARE INCH
	D73-D74	60	1	977.	52.	18.	23.	POUNDS PER SQUARE INCH
STRESS AT 300% ELONGATION	D71-D72	60	1	6.779	.322	.121	.155	MEGAPASCALS
	D73-D74	60	1	6.738	.357	.127	.158	MEGAPASCALS

PRECISION OF METHODS

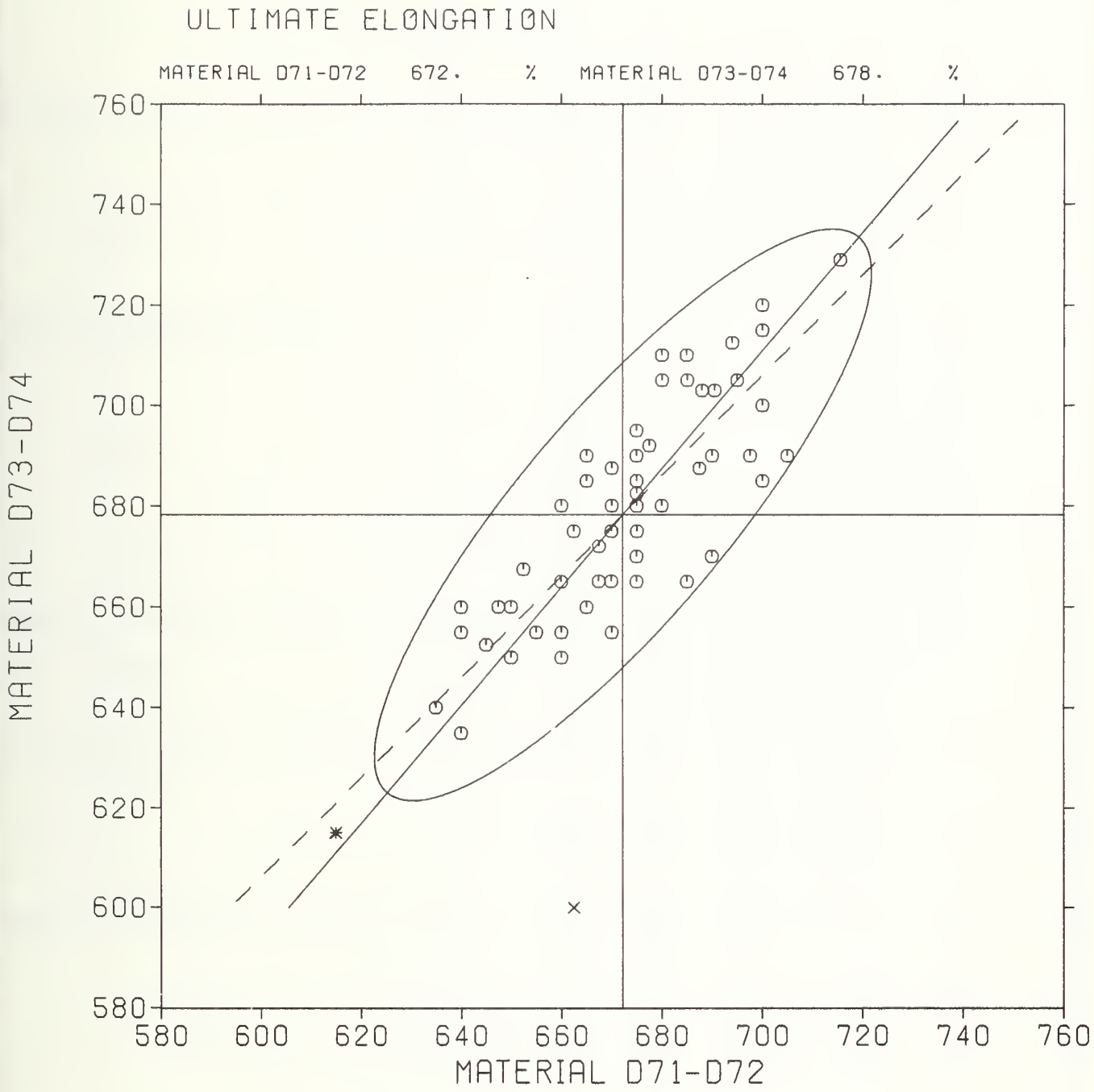
PROPERTY	MATERIAL	REPL CLP	REPL ASTM	GR.MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
TENSILE STRENGTH	D71-D72	5	5	2706.	183.	294.	PSI	6.8	10.9
	D73-D74	5	5	2724.	171.	365.	PSI	6.3	13.4
TENSILE STRENGTH	D71-D72	5	5	18.66	1.27	2.03	MEGAPA	6.8	10.9
	D73-D74	5	5	18.79	1.18	2.52	MEGAPA	6.3	13.4
ULTIMATE ELONGATION	D71-D72	5	5	672.	45.	54.	%	6.7	8.0
	D73-D74	5	5	678.	40.	62.	%	5.9	9.2
STRESS AT 300% ELONGATION	D71-D72	5	5	983.	62.	129.	PSI	6.4	13.2
	D73-D74	5	5	977.	63.	143.	PSI	6.5	14.7
STRESS AT 300% ELONGATION	D71-D72	5	5	6.779	.431	.892	MEGAPA	6.4	13.2
	D73-D74	5	5	6.738	.437	.988	MEGAPA	6.5	14.7

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
TENSILE STRENGTH - POUNDS PER SQUARE INCH

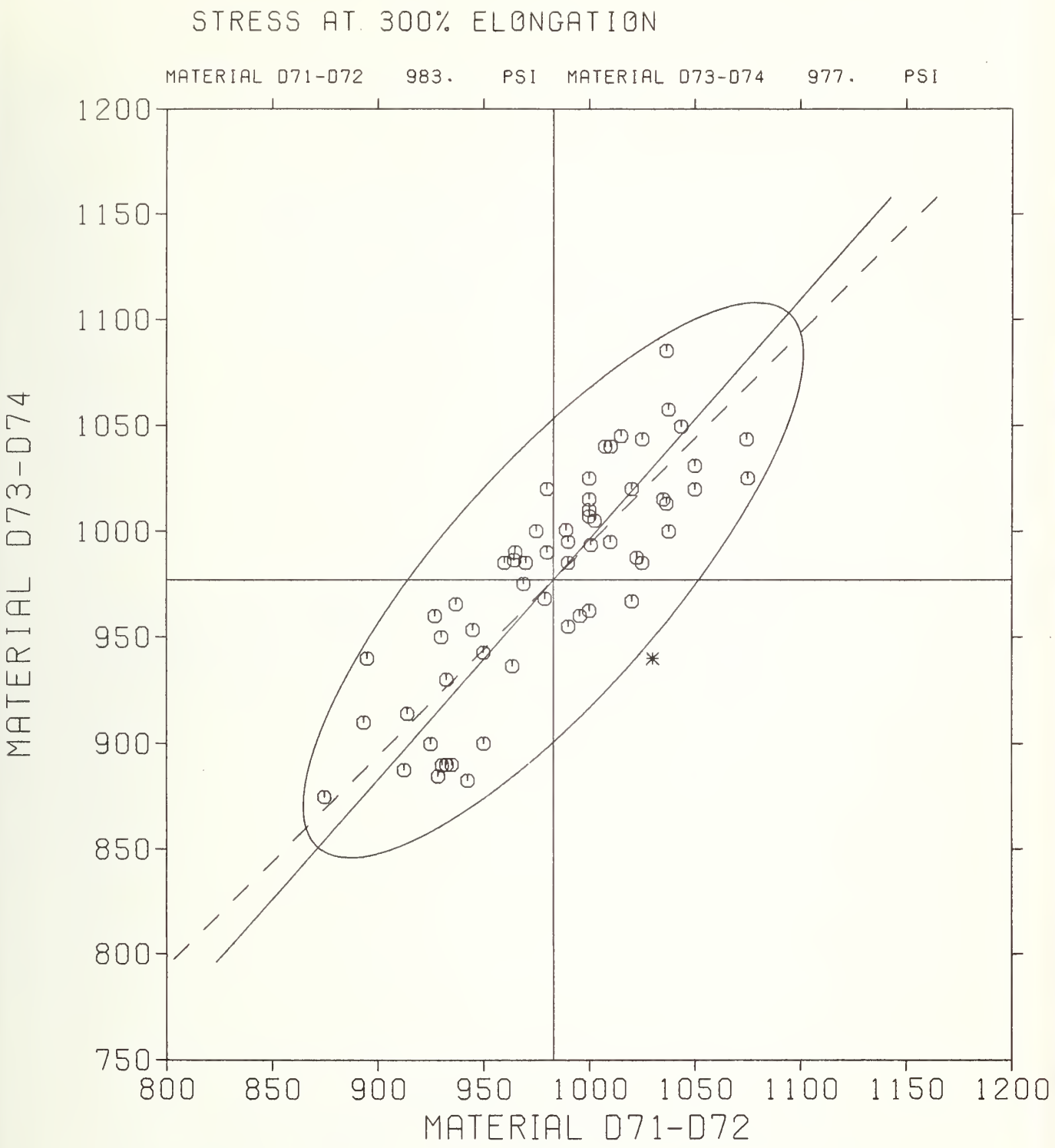
LAB CODE	F	MATERIAL D71-D72 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MATERIAL D73-D74 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0075	*	2434.	16.79	-10.0	.71	2385.	16.45	-12.4	1.04	01	
V0076		2795.	19.28	3.3	1.38	2810.	19.38	3.2	.79	01	
V0078		2497.	17.22	-7.7	.55	2519.	17.38	-7.5	.70	01	
V0081		2725.	18.79	.7	1.23	2725.	18.79	.0	.74	01	
V0083		2790.	19.24	3.1	.68	2800.	19.31	2.8	.87	01	
V0084		2620.	18.07	-3.2	1.03	2660.	18.34	-2.3	1.25	01	
V0085		2709.	18.68	.1	.91	2653.	18.30	-2.6	.78	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0087		2650.	18.28	-2.1	.93	2730.	18.83	.2	1.48	01	
V0088		2462.	16.98	-9.0	.85	2431.	16.77	-10.7	1.30	01	
V0092		2830.	19.52	4.6	1.00	2795.	19.28	2.6	1.91	01	
V0095		2770.	19.10	2.4	1.70	2792.	19.26	2.5	1.68	01	
V0096		2580.	17.79	-4.6	1.02	2585.	17.83	-5.1	.39	01	
V0100		2735.	18.86	1.1	1.37	2740.	18.90	.6	1.50	01	
V0111		2680.	18.48	-.9	.80	2650.	18.28	-2.7	1.36	01	
V0117		2587.	17.84	-4.4	.36	2525.	17.41	-7.3	.66	01	
V0122		2790.	19.24	3.1	1.46	2825.	19.48	3.7	.61	01	
V0123		2735.	18.86	1.1	.58	2725.	18.79	.0	.81	01	
V0126		2792.	19.25	3.2	1.11	2843.	19.61	4.4	.91	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0128		2715.	18.72	.3	.79	2705.	18.66	-.7	1.71	01	
V0141	*	3006.	20.73	11.1	.99	3000.	20.69	10.1	1.51	01	
V0144		2870.	19.79	6.1	1.01	2890.	19.93	6.1	1.11	01	
V0144B		2665.	18.38	-1.5	1.12	2745.	18.93	.8	1.13	01	
V0146		2706.	18.67	.0	.68	2668.	18.40	-2.0	1.15	01	
V0148		2875.	19.83	6.3	2.62X	2975.	20.52	9.2	1.23	01	
V0149		2755.	19.00	1.8	.52	2792.	19.26	2.5	.92	01	
V0150		2745.	18.93	1.5	1.08	2895.	19.97	6.3	.88	01	
V0151		2510.	17.31	-7.2	.68	2450.	16.90	-10.1	.65	01	
V0152		2825.	19.48	4.4	1.47	2900.	20.00	6.5	.69	01	
V0153		2581.	17.80	-4.6	.85	2640.	18.21	-3.1	.73	01	
V0154		2575.	17.76	-4.8	.51	2610.	18.00	-4.2	1.07	01	
V0156		2770.	19.10	2.4	1.50	2830.	19.52	3.9	.68	01	
V0158		2683.	18.50	-.8	1.06	2719.	18.75	-.2	1.27	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0159		2615.	18.03	-3.3	1.51	2660.	18.34	-2.3	.75	01	
V0160		2742.	18.91	1.4	1.53	2715.	18.72	-.3	1.47	01	
V0164		2735.	18.86	1.1	1.17	2797.	19.29	2.7	.57	01	
V0166		2800.	19.31	3.5	.77	2718.	18.75	-.2	1.20	01	
V0168		2772.	19.12	2.5	1.07	2881.	19.87	5.8	1.98X	01	
V0169		2589.	17.85	-4.3	.94	2502.	17.25	-8.1	.55	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0176		2655.	18.31	-1.9	1.26	2705.	18.66	-.7	.55	01	
V0177		2755.	19.00	1.8	.67	2825.	19.48	3.7	.87	01	
V0178		2700.	18.62	-.2	1.17	2700.	18.62	-.9	1.22	01	
V0184		2720.	18.76	.5	1.06	2840.	19.59	4.3	1.56	01	
V0199		2683.	18.50	-.8	1.24	2725.	18.79	.0	.54	01	
V0200		2724.	18.79	.7	1.32	2853.	19.68	4.8	.92	01	
V0206		2505.	17.28	-7.4	.53	2465.	17.00	-9.5	.62	01	
V0207		2712.	18.71	.3	.75	2725.	18.79	.0	.48	01	
V0208		2795.	19.31	3.5	2.23X	2937.	20.26	7.8	1.13	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0220		2750.	18.97	1.6	.88	2775.	19.14	1.5	.87	01	
V0223		2700.	18.62	-.2	1.83	2720.	18.76	-.1	.88	01	
V0224		2607.	17.98	-3.6	1.47	2557.	17.64	-6.1	1.67	01	
V0225		2656.	18.32	-1.8	.87	2656.	18.32	-2.5	.88	01	
V0232		2640.	18.21	-2.4	.97	2710.	18.69	-.5	.98	01	
V0233		2757.	19.02	1.5	.98	2850.	19.66	4.6	1.18	01	
V0235		2667.	18.40	-1.4	.89	2656.	18.32	-2.5	1.38	01	
V0238		2737.	18.88	1.2	1.12	2837.	19.57	4.2	1.28	01	
V0243		2734.	18.86	1.0	.39	2718.	18.74	-.2	.90	01	
V0244		2759.	19.03	2.0	1.22	2646.	18.25	-2.9	1.30	21	ORIGINAL IN KILOGRAMS/SQ. CENTIMETER
V0245A		2786.	19.21	3.0	.56	2754.	19.27	2.6	.52	01	
V0245B		2695.	18.59	-.4	.99	2681.	18.49	-1.6	.61	01	
V0246	X	2552.	17.60	-5.7	1.57	2359.	16.27	-13.4	1.52	01	
V0250	*	2875.	19.83	6.3	.90	2762.	19.05	1.4	.61	01	
		2706.	18.66	* GR. MEAN *		2724.	18.79				5 TEST DETERMINATIONS
		106.	.73	* SD MEANS *		132.	.91				60 LABORATORIES IN GRAND MEANS
		66.	.46	* AVER SDR *		62.	.43				61 LABORATORIES REPORTING
		PSI	MEGAPA	* UNIT *		PSI	MEGAPA				


TENSILE STRENGTH
MATERIAL D71-D72 2706. PSI MATERIAL D73-D74 2724. PSI
MATERIAL D73-D74
3200
3100
3000
2900
2800
2700
2600
2500
2400
2300
2200
2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200
MATERIAL D71-D72

LAB CODE	F	MATERIAL D71-D72 COMMERCIAL TIRE TREAD MEAN %	% DEV	REL SDR	MATERIAL D73-D74 COMMERCIAL TIRE TREAD MEAN %	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0075	X	577.	-14.1	.68	567.	-16.3	.66	01	
V0076		675.	.4	1.42	680.	.3	1.07	01	
V0078		655.	-2.6	.72	655.	-3.4	.98	01	
V0081		640.	-4.8	.81	655.	-3.4	1.16	01	
V0083		688.	2.3	.72	688.	1.4	1.30	01	
V0084		655.	-2.6	.70	655.	-3.4	1.24	01	
V0085		700.	4.1	.95	720.	6.2	.83	01	
V0087		667.	-.7	1.12	672.	-.9	1.84	01	
V0088		688.	2.3	1.33	703.	3.6	.93	01	
V0092		660.	-1.8	.28	650.	-4.2	1.30	01	
V0095		670.	-.3	1.57	688.	1.4	1.86	01	
V0096		690.	2.7	1.33	703.	3.6	.69	01	
V0100		675.	.4	1.28	675.	-.5	1.30	01	
V0111		715.	6.4	.98	729.	7.5	1.56	01	
V0117		660.	-1.8	.14	655.	-3.4	.43	01	
V0122		700.	4.1	1.76	715.	5.4	.82	01	
V0123		670.	-.3	.43	655.	-3.4	1.07	01	
V0126		677.	.8	1.25	692.	2.0	1.05	01	
V0128		690.	2.6	.66	690.	1.7	1.21	01	
V0141		675.	.4	.72	685.	1.0	1.01	01	
V0144		700.	4.1	1.17	685.	1.0	1.15	01	
V0144B		680.	1.2	.74	705.	3.9	1.47	01	
V0146		700.	4.1	1.30	700.	3.2	1.73	01	
V0148		675.	.4	2.32X	682.	.6	.28	01	
V0149		647.	-3.7	.70	660.	-2.7	.65	01	
V0150		685.	1.9	1.17	710.	4.7	.95	01	
V0151		690.	2.6	.55	670.	-1.2	.58	01	
V0152		670.	-.3	1.33	675.	-.5	.58	01	
V0153		688.	2.3	.89	688.	1.4	.61	01	
V0154		650.	-3.3	.36	660.	-2.7	.98	01	
V0156		660.	-1.8	1.47	665.	-2.0	.68	01	
V0158		675.	.4	1.22	695.	2.5	1.56	01	
V0159		675.	.4	1.56	670.	-1.2	.83	01	
V0160		665.	-1.1	1.19	660.	-2.7	1.84	01	
V0164		694.	3.2	1.47	712.	5.1	.84	01	
V0166		685.	1.9	.77	665.	-2.0	1.26	01	
V0168		660.	-1.8	2.93X	680.	.3	1.06	01	
V0169		640.	-4.8	.77	635.	-6.4	.77	01	
V0176		680.	1.2	1.20	710.	4.7	.86	01	
V0177		695.	3.4	.53	705.	3.9	.60	01	
V0178		670.	-.3	1.50	680.	.3	1.49	01	
V0184		680.	1.2	1.98X	680.	.3	1.54	01	
V0199		685.	1.9	1.72	705.	3.9	.79	01	
V0200		665.	-1.1	.73	690.	1.7	.79	01	
V0206	*	615.	-8.5	.44	615.	-9.3	.31	01	
V0207		650.	-3.3	.31	650.	-4.2	.24	01	
V0208		640.	-4.8	2.01X	660.	-2.7	1.09	01	
V0220		667.	-.7	.97	665.	-2.0	.76	01	
V0223		670.	-.3	1.84	675.	-.5	1.00	01	
V0224		652.	-2.9	1.73	667.	-1.6	1.47	01	
V0225		645.	-4.0	1.15	652.	-3.8	.44	01	
V0232		675.	.4	1.02	690.	1.7	1.35	01	
V0233		665.	-1.1	.48	685.	1.0	.87	01	
V0235		635.	-5.5	.65	640.	-5.6	.44	01	
V0238		662.	-1.4	.77	675.	-.5	.86	01	
V0243		670.	-.3	.36	665.	-2.0	.89	01	
V0244		705.	4.9	1.37	690.	1.7	1.18	01	
V0245A		670.	-.3	.87	680.	.3	.76	01	
V0245B		675.	.4	1.14	665.	-2.0	1.03	01	
V0246	X	662.	-1.4	.64	600.	-11.5	1.78	01	
V0250		697.	3.8	.53	690.	1.7	.70	01	
		672.	* GR. MEAN *		678.				5 TEST DETERMINATIONS
		20.	* SD MEANS *		22.				59 LABORATORIES IN GRAND MEANS
		16.	* AVER SDR *		14.				61 LABORATORIES REPORTING
		%	* UNIT *		%				


ULTIMATE ELONGATION
MATERIAL D71-D72 672. %
MATERIAL D73-D74 678. %
760
740
720
700
680
660
640
620
600
580
MATERIAL D73-D74
580 600 620 640 660 680 700 720 740 760
MATERIAL D71-D72

LAB CODE	F	MATERIAL D71-D72 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MATERIAL D73-D74 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0079		1036.	7.148	5.4	.93	1085.	7.485	11.1	.68	01	
V0076		1035.	7.138	5.3	.99	1015.	7.000	3.9	1.13	01	
V0078		963.	6.645	-2.0	1.52	936.	6.455	-4.1	1.58	01	
V0081		1000.	6.897	1.7	1.10	962.	6.638	-1.5	1.43	01	
V0083		1010.	6.966	2.7	.72	995.	6.862	1.8	1.31	01	
V0084		980.	6.759	-.3	1.17	990.	6.828	1.3	1.25	01	
V0085		930.	6.417	-5.3	1.22	890.	6.137	-8.9	.50	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0087		1020.	7.034	3.8	.58	1020.	7.034	4.4	1.04	01	
V0088	X	845.	5.826	-14.1	2.75X	784.	5.408	-19.7	1.12	01	
V0092	*	1030.	7.103	4.8	1.42	940.	6.483	-3.8	1.00	01	
V0095		990.	6.828	.7	.80	955.	6.586	-2.2	.98	01	
V0096		928.	6.403	-5.5	1.01	884.	6.100	-9.5	1.06	01	
V0100		895.	6.172	-9.0	1.50	940.	6.483	-3.8	1.42	01	
V0111		950.	6.552	-3.4	.69	900.	6.207	-7.9	.37	01	
V0117		912.	6.293	-7.2	2.22X	887.	6.121	-9.2	1.49	01	
V0122		942.	6.500	-4.1	.96	882.	6.086	-9.7	.90	01	
V0123		980.	6.759	-.3	1.14	1020.	7.034	4.4	.95	01	
V0126		979.	6.752	-.4	1.09	968.	6.677	-.9	1.11	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0128		1025.	7.069	4.3	.67	985.	6.793	.8	.66	01	
V0141		1074.	7.410	9.3	1.16	1043.	7.197	6.8	2.00X	01	
V0144		1015.	7.000	3.3	.91	1045.	7.207	7.0	1.37	01	
V0144B		935.	6.448	-4.9	1.46	890.	6.138	-8.9	1.47	01	
V0146		932.	6.431	-5.1	1.00	930.	6.414	-4.8	.62	01	
V0148		1037.	7.155	5.5	.89	1057.	7.293	8.2	1.04	01	
V0149		1036.	7.148	5.4	.94	1013.	6.986	3.7	.68	01	
V0150		1002.	6.914	2.0	.72	1005.	6.931	2.9	.71	01	
V0151		925.	6.379	-5.9	.92	900.	6.207	-7.9	.54	01	
V0152		1050.	7.241	6.8	.82	1020.	7.034	4.4	.50	01	
V0153		893.	6.162	-9.1	3.09X	910.	6.276	-6.9	2.51X	01	
V0154		990.	6.828	.7	.26	985.	6.793	.8	.82	01	
V0156		1010.	6.966	2.7	.57	1040.	7.172	6.5	1.24	01	
V0158		965.	6.652	-1.9	1.10	986.	6.802	1.0	1.64	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0159		965.	6.655	-1.8	1.44	990.	6.828	1.3	.96	01	
V0160		1007.	6.946	2.5	.83	1040.	7.172	6.5	1.06	01	
V0164		945.	6.517	-3.9	1.16	953.	6.576	-2.4	.41	01	
V0166		1000.	6.897	1.7	1.05	1007.	6.945	3.1	.81	01	
V0168		985.	6.821	.6	1.33	1000.	6.900	2.4	1.21	01	
V0169		950.	6.552	-3.4	.84	943.	6.502	-3.5	.63	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0176		932.	6.431	-5.1	.80	890.	6.138	-8.9	1.79	01	
V0177		930.	6.414	-5.4	.71	950.	6.552	-2.8	.57	01	
V0178		1075.	7.414	9.4	.93	1025.	7.069	4.9	1.51	01	
V0184		965.	6.683	-1.4	.66	975.	6.724	-.2	1.67	01	
V0199		1000.	6.897	1.7	1.45	1025.	7.069	4.9	.71	01	
V0200		927.	6.393	-5.7	.78	960.	6.621	-1.7	.65	01	
V0206		970.	6.690	-1.3	.59	985.	6.793	.8	.92	01	
V0207		1000.	6.897	1.7	.88	1015.	7.000	3.9	.74	01	
V0208		1001.	6.902	1.8	2.33X	994.	6.852	1.7	2.65X	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0220		1000.	6.897	1.7	1.05	1010.	6.966	3.4	.92	01	
V0223		990.	6.828	.7	1.27	995.	6.862	1.8	1.13	01	
V0224		1022.	7.052	4.0	1.35	987.	6.810	1.1	2.86X	01	
V0225		1050.	7.241	6.8	.98	1031.	7.110	5.5	1.55	01	
V0232		960.	6.621	-2.3	1.09	985.	6.793	.8	1.32	01	
V0233		1025.	7.069	4.3	.80	1043.	7.197	6.8	.85	01	
V0235		1043.	7.197	6.2	.76	1049.	7.238	7.4	.72	01	
V0238		975.	6.724	-.8	.99	1000.	6.897	2.4	.70	01	
V0243		914.	6.303	-7.0	.92	914.	6.303	-6.4	1.31	01	
V0244		875.	6.033	-11.0	1.29	875.	6.033	-10.5	.73	21	ORIGINAL IN KILOGRAMS/SQ. CENTIMETER
V0245A		1020.	7.034	3.8	2.09X	967.	6.669	-1.0	1.03	01	
V0245B		995.	6.866	1.3	1.77	960.	6.621	-1.7	1.36	01	
V0246		937.	6.462	-4.7	1.13	965.	6.659	-1.2	.87	01	
V0250		1037.	7.155	5.5	1.16	1000.	6.897	2.4	.39	01	
		983.	6.779	* GR. MEAN *		977.	6.738				5 TEST DETERMINATIONS
		47.	.322	* SD MEANS *		52.	.357				60 LABORATORIES IN GRAND MEANS
		23.	.155	* AVER SDR *		23.	.158				61 LABORATORIES REPORTING
		PSI	MEGAPA	* UNIT *		PSI	MEGAPA				


STRESS AT 300% ELONGATION
MATERIAL D71-D072 983. PSI MATERIAL D73-D074 977. PSI
1200
1150
1100
1050
1000
950
900
850
800
750
MATERIAL D73-D74
800 850 900 950 1000 1050 1100 1150 1200
MATERIAL D71-D72

HARDNESS

NOTES

Materials D71 and D72 were sheets of the same vulcanized rubber. Similarly, materials D73 and D74 were alike.

V100 results were obtained at NBS using ASTM D1415. V200 results were obtained at NBS using ASTM D2240.

Five of the 27 participants reporting used ASTM D1415 (Wallace) for the hardness determination. All others used ASTM D2240 (Type A Durometer).

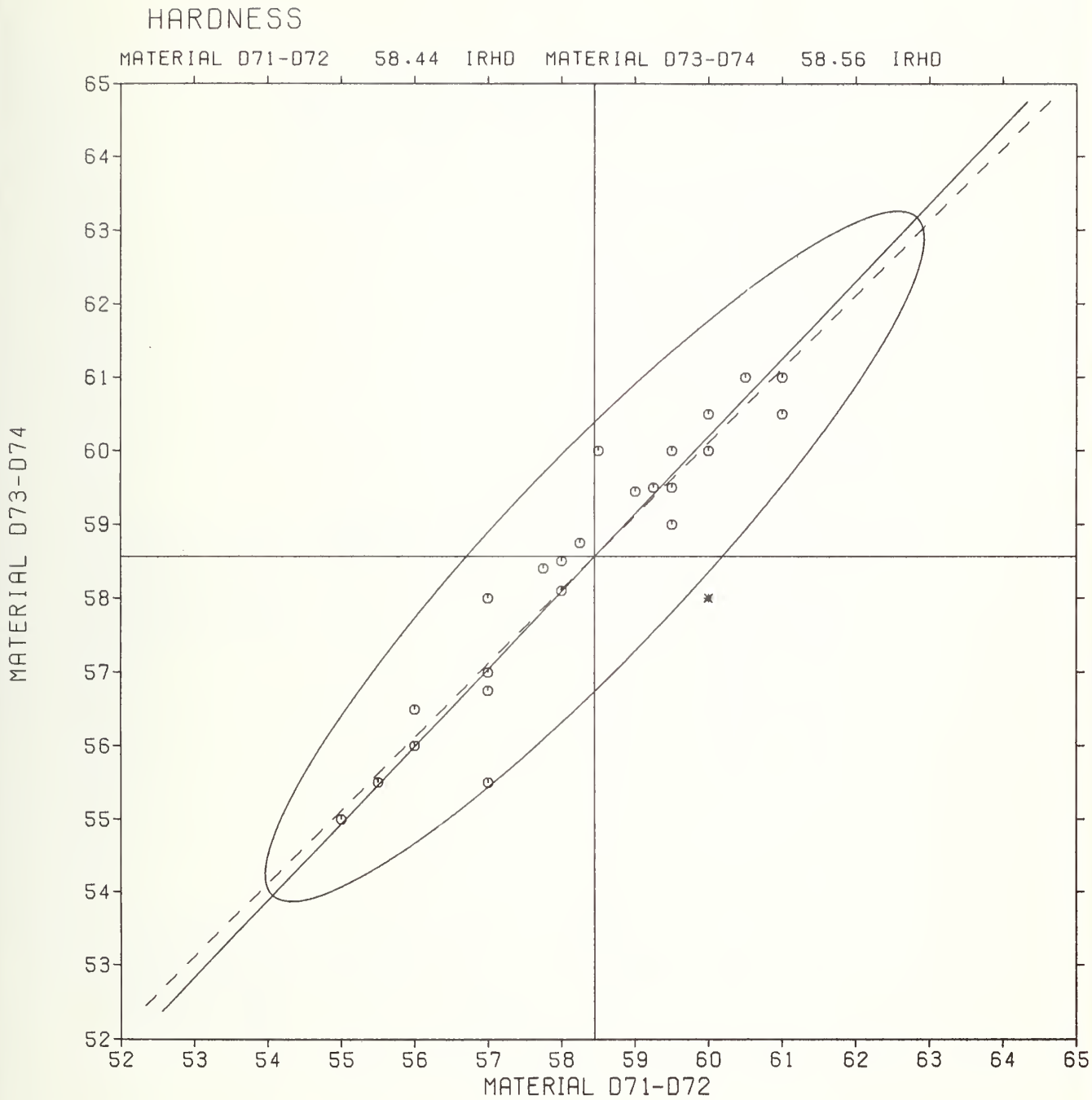
SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR.MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
HARDNESS	D71-D72	27	0	58.44	1.69	.22	.47	IRHD
	D73-D74	27	0	58.56	1.77	.19	.53	IRHD

PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR.MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
HARDNESS	D71-D72	5	5	58.44	1.30	4.68	IRHD	2.2	8.0
	D73-D74	5	5	58.56	1.48	4.90	IRHD	2.5	8.4

LAB CODE	F	MATERIAL D71-D72 COMMERCIAL TIRE TREAD MEAN IRHD	% DEV	REL SDR	MATERIAL D73-D74 COMMERCIAL TIRE TREAD MEAN IRHD	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0078		59.50	1.8	.95	59.00	.7	.93	01	
V0081		59.50	1.8	1.79	59.50	1.6	1.03	01	
V0084		60.00	2.7	1.06	60.50	3.3	1.03	01	
V0085		59.00	1.0	.62	59.45	1.5	.71	01	
V0087		58.50	.1	5.52X	60.00	2.5	1.26	01	
V0088		56.00	-4.2	1.37	56.00	-4.4	1.08	01	
V0092		56.00	-4.2	1.65	56.50	-3.5	1.62	01	
V0100		58.00	-.8	.65	58.10	-.8	.54	01	
V0111		61.00	4.4	.58	60.50	3.3	.00	01	
V0122		58.25	-.3	.92	58.75	.3	.65	01	
V0128		55.50	-5.0	.58	55.50	-5.2	.00	01	
V0141		57.00	-2.5	.88	55.50	-5.2	1.35	01	
V0144		60.50	3.5	1.17	61.00	4.2	.00	01	
V0144B		61.00	4.4	.89	61.00	4.2	1.18	01	
V0168		59.25	1.4	.82	59.50	1.6	.65	01	
V0169	*	60.00	2.7	.48	58.00	-1.0	.00	01	
V0176		60.00	2.7	1.26	60.00	2.5	1.33	01	
V0200		57.00	-2.5	.67	56.75	-3.1	.51	01	
V0206		57.00	-2.5	.48	57.00	-2.7	.93	01	
V0208		57.75	-1.2	1.24	58.40	-.3	1.94X	01	
V0214		57.00	-2.5	3.33X	58.00	-1.0	2.55X	01	
V0224		55.00	-5.5	.00	55.00	-5.1	.00	01	
V0233		60.00	2.7	1.78	60.00	2.5	1.08	01	
V0235		58.25	-.3	1.24	58.75	.3	.60	01	
V0243		58.00	-.8	.58	58.50	-.1	.00	01	
V0244		59.50	1.8	1.17	60.00	2.5	.93	01	
V0246		59.50	1.8	1.17	60.00	2.5	1.57	01	
		58.44	- GR. MEAN -		58.56				5 TEST DETERMINATIONS
		1.69	- SD MEANS -		1.77				27 LABORATORIES IN GRAND MEANS
		.47	- AVER SDR -		.53				27 LABORATORIES REPORTING
		IRHD	- UNIT -		IRHD				


HARDNESS
MATERIAL D71-D72 58.44 IRHD MATERIAL D73-D74 58.56 IRHD
MATERIAL D73-D74
MATERIAL D71-D72
65
64
63
62
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55
54
53
52
52 53 54 55 56 57 58 59 60 61 62 63 64 65

MOONEY VISCOSITY

NOTES

Materials U71 and U72 were the same rubber. Similarly, materials U73 and U74 were the same rubber. No sample preparation was required for materials U71 and U72 whereas, mill massing was required for materials U73 and U74.

V100 results were obtained at NBS on the manually closed viscometer used for determining the Mooney viscosities of the standard rubbers.

SUMMARY OF ANALYSES

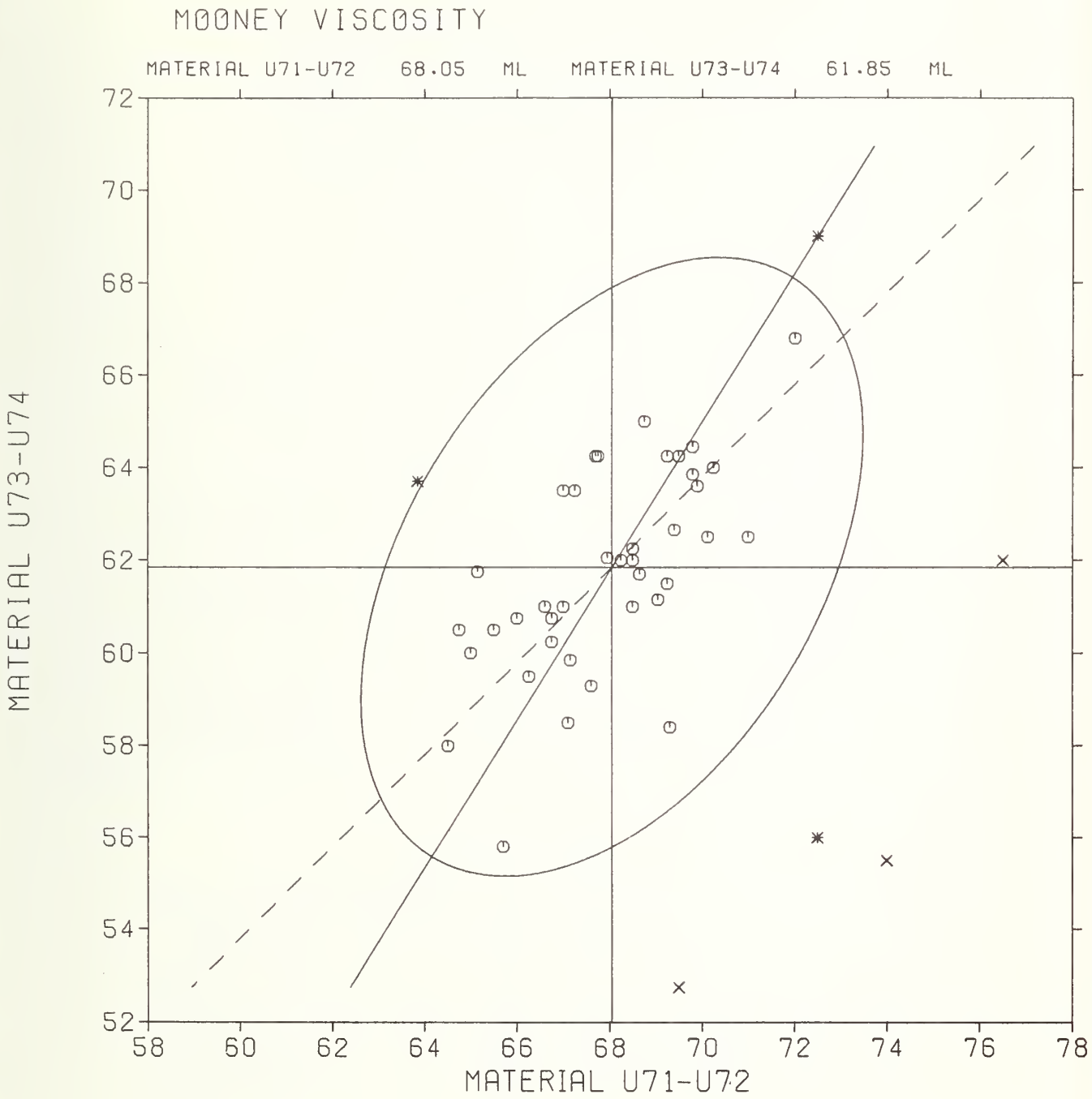
PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR.MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
MOONEY	U71-U72	42	4	68.05	2.11	.28	.38	ML
VISCOSITY	U73-U74	42	4	61.85	2.00	.38	.50	ML

PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CHP	REPL ASTM	GR.MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
MOONEY	U71-U72	3	3	68.05	1.04	5.84	ML	1.5	8.6
VISCOSITY	U73-U74	3	3	61.85	1.39	7.20	ML	2.2	11.6

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
MOONEY VISCOSITY - ML

LAB CODE	F	MATERIAL U71-U72 BUTYL RUBBER MEAN ML	% DEV	REL SDR	MATERIAL U73-U74 SBR MEAN ML	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0075	X	50.00	-26.5	2.66X	51.50	-16.7	4.06X	01	
V0077		67.15	-1.3	1.12	59.85	-3.2	1.20	01	
V0078	*	63.85	-6.2	2.51X	63.70	3.0	1.35	01	
V0079		69.80	2.6	1.78	63.85	3.2	1.08	01	
V0080		69.90	2.7	.40	63.60	2.8	1.73	01	
V0083		68.50	.7	.77	62.25	.7	1.05	01	
V0085		67.95	-.1	1.67	62.05	.3	1.24	01	
V0090		68.50	.7	.77	62.00	.2	1.72	01	
V0092		67.00	-1.5	1.54	63.50	2.7	.57	01	
V0093		66.60	-2.1	.93	61.00	-1.4	.95	01	
V0095		68.25	.3	.77	62.00	.2	1.05	01	
V0100		66.65	.9	.51	61.70	-.2	.62	01	
V0111		67.10	-1.4	1.28	58.50	-5.4	.81	01	
V0117		66.25	-2.6	2.83X	59.50	-3.8	2.25	01	
V0120		72.00	5.8	.58	66.80	8.0	.82	01	
V0122		64.75	-4.8	1.43	60.50	-2.2	1.05	01	
V0128		67.25	-1.2	1.43	63.50	2.7	.86	01	
V0144	X	69.50	2.1	1.43	52.75	-14.7	1.15	01	
V0146		68.75	1.0	.77	65.00	5.1	.57	01	
V0148	*	72.50	6.5	8.14X	56.00	-9.5	2.30	01	
V0149		69.80	2.6	.71	64.45	4.2	.57	01	
V0150		69.30	1.8	.84	58.40	-5.6	.87	01	
V0156		66.00	-3.0	.00	60.75	-1.8	1.07	01	
V0166		67.75	-.4	.66	64.25	3.9	.57	01	
V0169		70.12	3.1	1.10	62.50	1.1	.29	01	
V0177		65.15	-4.3	.83	61.75	-.2	.81	01	
V0178		68.50	.7	.38	61.00	-1.4	1.32	01	
V0182		66.75	-1.9	.77	60.25	-2.6	.57	01	
V0190		67.60	-.7	1.02	59.30	-4.1	.70	01	
V0206		71.00	4.3	1.15	62.50	1.1	.86	01	
V0207		69.40	2.0	.68	62.65	1.3	.77	01	
V0208		67.00	-1.5	1.33	61.00	-1.4	1.15	01	
V0211		69.25	1.8	1.40	64.25	3.9	.86	01	
V0213		66.75	-1.9	.38	60.75	-1.8	1.15	01	
V0214		65.00	-4.5	1.33	60.00	-3.0	1.15	01	
V0218		69.25	1.8	.84	61.50	-.6	.29	01	
V0220		69.05	1.5	2.05	61.15	-1.1	3.09X	01	
V0221		70.25	3.2	.77	64.00	3.5	.86	01	
V0223		69.50	2.1	.38	64.25	3.9	.50	01	
V0230		65.70	-3.5	1.14	55.80	-9.8	.35	01	
V0236	*	72.50	6.5	1.54	69.00	11.6	1.57	01	
V0238		64.50	-5.2	.77	58.00	-6.2	.57	01	
V0244	X	74.00	8.7	1.54	55.50	-10.3	1.52	01	
V0246	X	76.50	12.4	.77	62.00	.2	1.15	01	
V0250		65.50	-3.7	1.54	60.50	-2.2	1.15	01	
V0251		67.70	-.5	1.27	64.25	3.9	1.76	01	
		68.05	* GR. MEAN *		61.85				3 TEST DETERMINATIONS
		2.11	* SD MEANS *		2.60				42 LABORATORIES IN GRAND MEANS
		.38	* AVER SDR *		.50				46 LABORATORIES REPORTING
		ML	* UNIT *		ML				


MOONEY VISCOSITY
MATERIAL U71-U72 68.05 ML
MATERIAL U73-U74 61.85 ML
MATERIAL U73-U74
MATERIAL U71-U72
72
70
68
66
64
62
60
58
56
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52
58
60
62
64
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68
70
72
74
76
78

VULCANIZATION CHARACTERISTICS USING OSCILLATING DISK CURE METER

NOTES

Materials Z71 and Z72 were the same rubber formulation. Similarly, materials Z73 and Z74 were alike.

V100 results were obtained at NBS using a Model TM-100 Monsanto Rheometer with a disk oscillating at ± 1° amplitude and 1.7 hertz frequency.

All participants used Monsanto Rheometers operated at one degree amplitude and 1.7 hertz frequency.

V144 data is meaningless due to a reporting error.

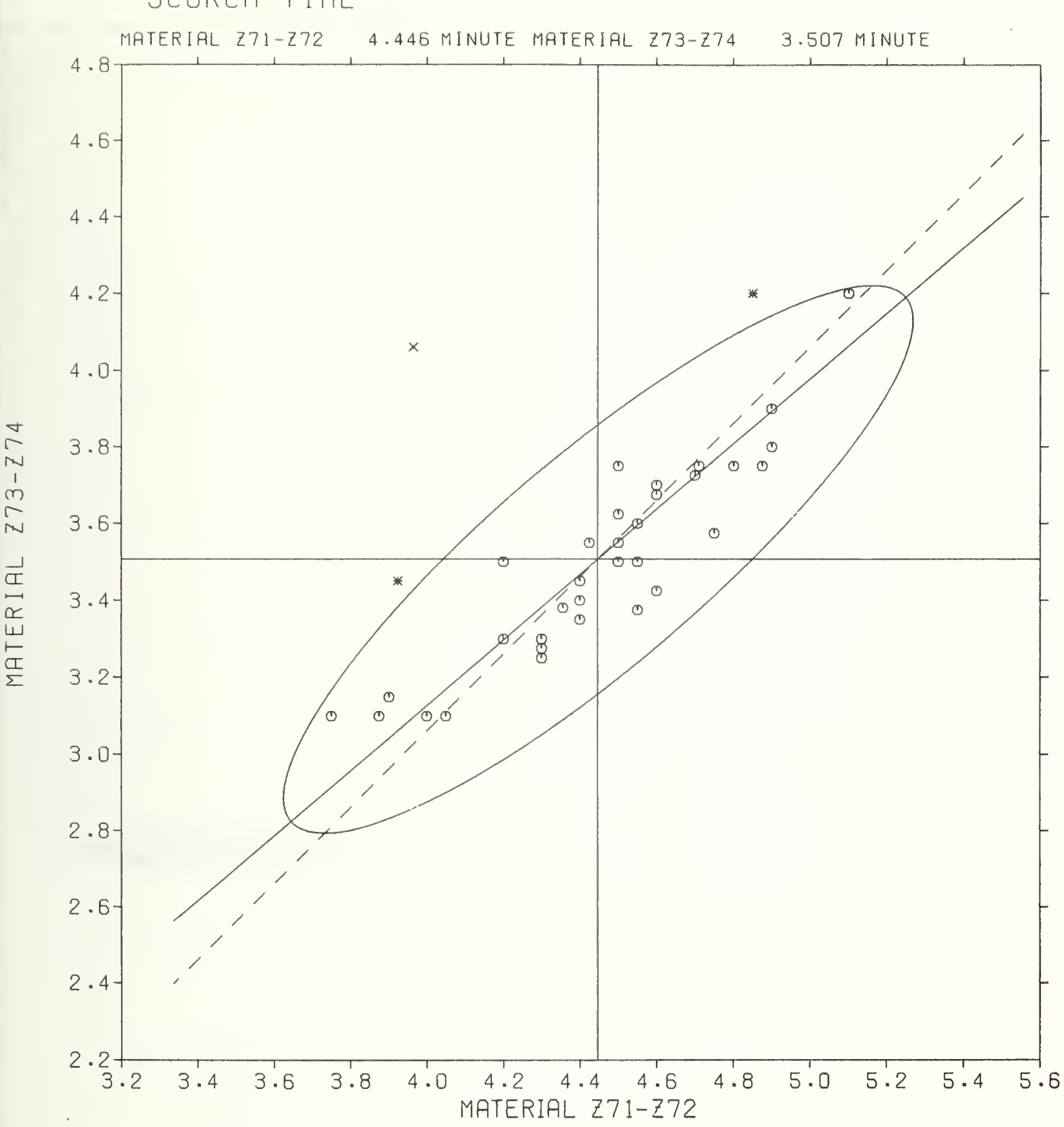
SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR.MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
SCORCH TIME	Z71-Z72	37	1	4.446	.317	.036	.074	MINUTES
	Z73-Z74	37	1	3.507	.275	.039	.053	MINUTES
CURE TIME (50% MB)	Z71-Z72	36	2	6.59	.40	.03	.07	MINUTES
	Z73-Z74	36	2	7.34	.47	.03	.06	MINUTES
CURE TIME (90% MB)	Z71-Z72	36	2	10.04	.59	.05	.12	MINUTES
	Z73-Z74	36	2	14.65	.92	.06	.13	MINUTES
MINIMUM TORQUE	Z71-Z72	35	3	4.92	.53	.04	.08	POUND-INCHES
	Z73-Z74	35	3	6.33	.58	.03	.08	POUND-INCHES
MINIMUM TORQUE	Z71-Z72	35	3	.5563	.0597	.0050	.0088	NEWTON-METERS
	Z73-Z74	35	3	.7154	.0661	.0038	.0095	NEWTON-METERS
MAXIMUM TORQUE	Z71-Z72	36	2	22.25	1.03	.04	.13	POUND-INCHES
	Z73-Z74	36	2	30.31	1.47	.04	.12	POUND-INCHES
MAXIMUM TORQUE	Z71-Z72	36	2	2.5139	.1160	.0046	.0152	NEWTON-METERS
	Z73-Z74	36	2	3.4251	.1665	.0049	.0139	NEWTON-METERS

PRECISION OF METHODS

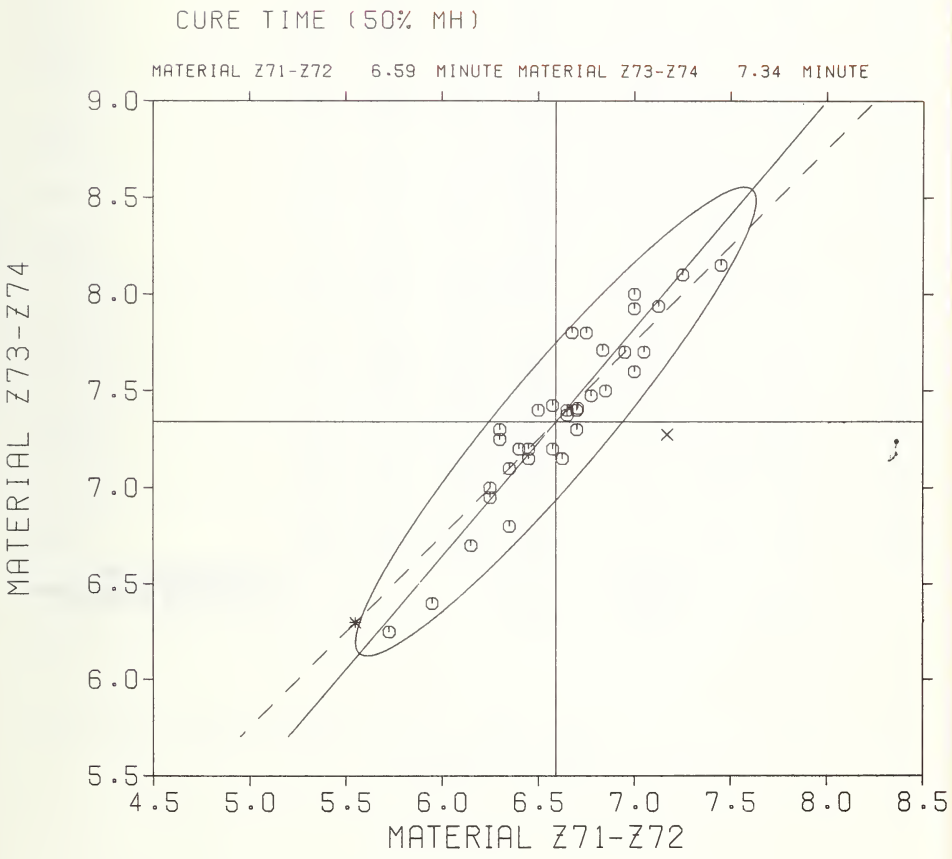
PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR.MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
SCORCH TIME	Z71-Z72	3	3	4.446	.204	.878	MINUTE	4.6	19.7
	Z73-Z74	3	3	3.507	.146	.762	MINUTE	4.2	21.7
CURE TIME (50% MB)	Z71-Z72	3	3	6.59	.20	1.11	MINUTE	3.0	16.8
	Z73-Z74	3	3	7.34	.16	1.30	MINUTE	2.2	17.7
CURE TIME (90% MB)	Z71-Z72	3	3	10.04	.34	1.62	MINUTE	3.4	16.1
	Z73-Z74	3	3	14.65	.37	2.56	MINUTE	2.5	17.5
MINIMUM TORQUE	Z71-Z72	3	3	4.92	.22	1.46	LB-IN.	4.4	29.7
	Z73-Z74	3	3	6.33	.23	1.62	LB-IN.	3.7	25.6
MINIMUM TORQUE	Z71-Z72	3	3	.5563	.0244	.1653	N-M	4.4	29.7
	Z73-Z74	3	3	.7154	.0263	.1830	N-M	3.7	25.6
MAXIMUM TORQUE	Z71-Z72	3	3	22.25	.37	2.84	LB-IN.	1.7	12.8
	Z73-Z74	3	3	30.31	.34	4.08	LB-IN.	1.1	13.5
MAXIMUM TORQUE	Z71-Z72	3	3	2.5139	.0421	.3214	N-M	1.7	12.8
	Z73-Z74	3	3	3.4251	.0386	.4611	N-M	1.1	13.5

LAB CODE	F	MATERIAL Z71-Z72 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL Z73-Z74 SBR MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0077		4.500	1.2	3.38X	3.750	6.9	1.00	01	
V0078		4.675	5.6	.00	3.750	6.9	.00	01	
V0079		4.550	2.3	2.35	3.375	-3.8	.00	01	
V0083		4.900	10.2	1.07	3.900	11.2	.55	01	
V0085		4.300	-3.3	1.30	3.275	-6.6	.55	01	
V0090		4.710	5.5	.46	3.750	6.9	.75	01	
V0092		4.600	3.5	.78	3.425	-2.3	3.28X	01	
V0093		4.600	3.5	.00	3.675	4.8	.55	01	
V0095		4.550	2.3	.78	3.500	-.2	1.64	01	
V0100		4.600	3.5	.39	3.700	5.5	.00	01	
V0117		3.875	-12.8	2.53X	3.100	-11.6	3.34X	01	
V0122		4.300	-3.3	1.43	3.300	-5.9	1.64	01	
V0128		4.400	-1.0	1.18	3.350	-4.5	.55	01	
V0144	X	3.965	-10.8	1.64	4.060	15.8	1.05	01	
V0149		4.500	1.2	1.27	3.500	-.2	.55	01	
V0150		5.100	14.7	2.07	4.200	19.8	2.51X	01	
V0152		4.550	2.3	.00	3.600	2.7	.00	01	
V0154		4.425	-.5	.59	3.550	1.2	.27	01	
V0156		4.500	1.2	.54	3.550	1.2	.55	01	
V0158		4.000	-10.0	3.36X	3.100	-11.6	.55	01	
V0159		4.750	6.8	.81	3.575	1.9	1.66	01	
V0161		4.300	-3.3	.39	3.300	-5.9	.00	01	
V0166		4.400	-1.0	.78	3.450	-1.6	.55	01	
V0169		4.300	-3.3	2.64X	3.250	-7.3	.55	01	
V0178		4.050	-8.9	1.18	3.100	-11.6	.00	01	
V0182		4.500	1.2	.98	3.625	3.4	1.52	01	
V0206		4.850	8.0	.68	3.750	6.9	.00	01	
V0207	*	4.650	9.1	.78	4.200	19.8	1.64	01	
V0208		4.355	-2.1	2.12	3.380	-3.6	.93	01	
V0211		3.900	-12.3	.39	3.150	-10.2	1.49	01	
V0213	*	3.925	-11.7	1.05	3.450	-1.6	2.55X	01	
V0214		4.700	5.7	1.07	3.725	6.2	3.88X	01	
V0218		4.400	-1.0	.78	3.400	-3.0	.55	01	
V0220		3.750	-15.7	3.51X	3.100	-11.6	2.18	01	
V0221		4.200	-5.5	.20	3.500	-.2	.55	01	
V0238		4.900	10.2	1.57	3.800	8.4	2.18	01	
V0243		4.200	-5.5	.00	3.300	-5.9	1.09	01	
V0246		4.400	-1.0	.00	3.350	-4.5	.00	01	
		4.446	• GR. MEAN •		3.507				3 TEST DETERMINATIONS
		.317	• SD MEANS •		.275				37 LABORATORIES IN GRAND MEANS
		.074	• AVER SDR •		.053				38 LABORATORIES REPORTING
		MINUTE	• UNIT •		MINUTE				


SCORCH TIME
MATERIAL Z71-Z72 4.446 MINUTE MATERIAL Z73-Z74 3.507 MINUTE
MATERIAL Z73-Z74
MATERIAL Z71-Z72
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6

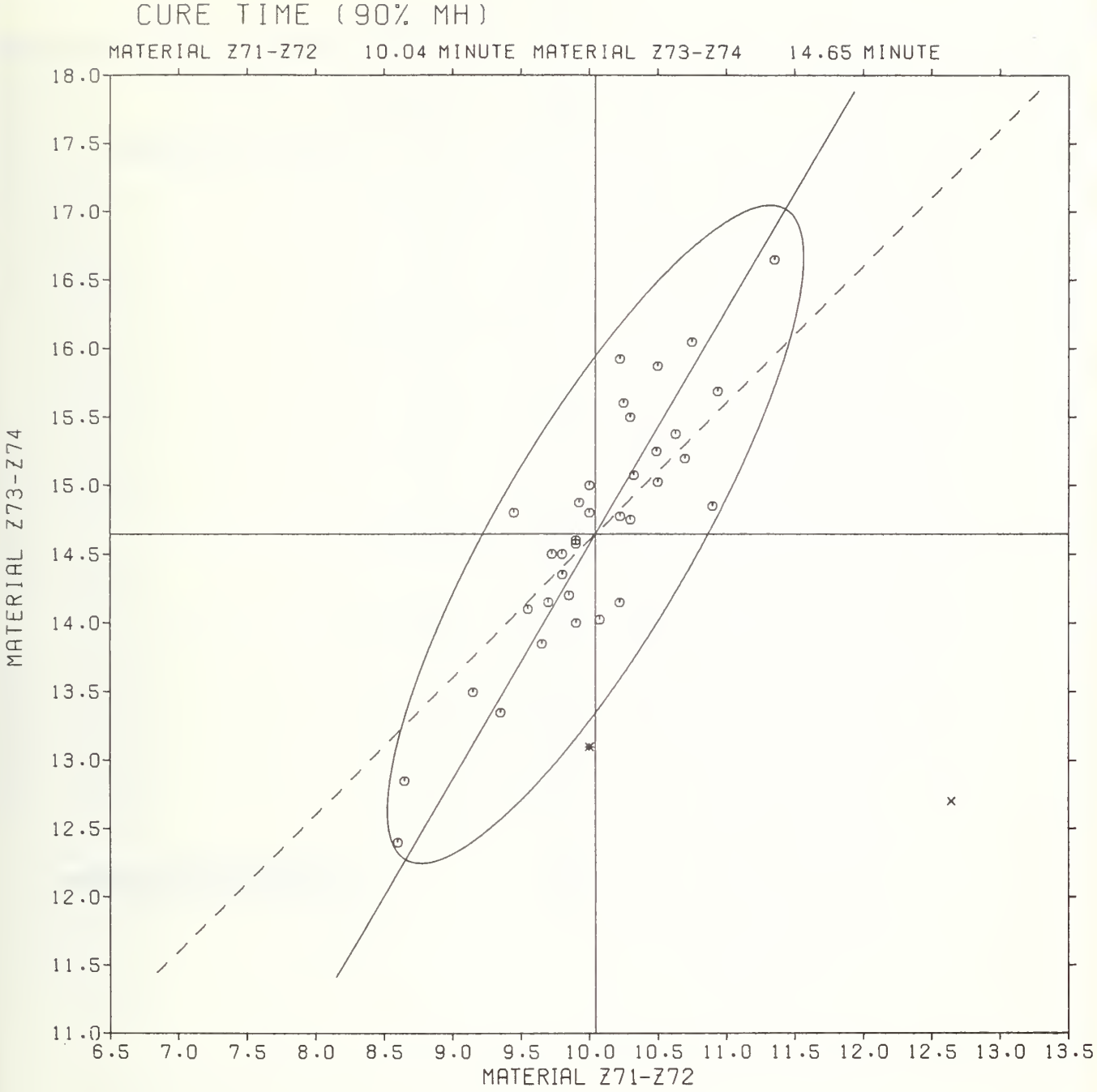
INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
CURE TIME (50% MR) - MINUTES

LAB CODE	F	MATERIAL Z71-Z72 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL Z73-Z74 SBR MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0077		6.67	1.3	2.76X	7.80	6.3	1.72	01	
V0078		7.12	6.1	.00	7.94	8.1	.00	01	
V0079		7.00	6.2	2.20	7.52	8.0	.49	01	
V0083		7.25	10.0	.80	8.10	10.3	.49	01	
V0085		6.62	.5	2.50X	7.15	-2.6	1.56	01	
V0090		6.83	3.7	.56	7.71	5.0	.43	01	
V0092		6.40	-2.9	1.09	7.20	-1.9	4.10X	01	
V0093		6.75	2.4	.20	7.80	6.3	.90	01	
V0095		6.65	.9	.80	7.40	.8	1.48	01	
V0100		6.70	1.7	.80	7.30	-.6	.98	01	
V0117		6.30	-4.4	1.38	7.25	-1.2	.49	01	
V0122		6.50	-1.4	.80	7.40	.8	.85	01	
V0128		6.25	-5.2	.80	7.00	-4.6	.98	01	
V0144	X	7.17	6.8	1.36	7.27	-.9	2.33	01	
V0149		6.77	2.8	.40	7.47	1.8	.25	01	
V0150		7.05	7.0	2.68	7.70	4.9	2.61X	01	
V0152		6.70	1.7	.00	7.40	.8	.00	01	
V0154		6.57	-.2	.55	7.42	1.2	.49	01	
V0156		6.57	-.2	.35	7.20	-1.9	.74	01	
V0158		5.95	-9.7	3.86X	6.40	-12.8	.98	01	
V0159		6.85	3.9	.60	7.50	2.2	1.14	01	
V0161		6.35	-3.7	.40	6.80	-7.4	.98	01	
V0166		6.40	-2.9	1.45	7.20	-1.9	.98	01	
V0169		6.35	-3.7	2.23	7.10	-3.3	1.79	01	
V0178		6.25	-5.2	1.05	6.95	-5.3	2.56X	01	
V0182		6.65	.9	.93	7.37	.5	1.62	01	
V0206		6.95	5.5	.80	7.70	4.9	.98	01	
V0207	X	6.45	-2.1	1.49	17.05	99.9	2.63X	01	
V0208		6.70	1.7	1.65	7.41	.9	1.08	01	
V0211		5.72	-13.1	.55	6.25	-14.9	1.78	01	
V0213		7.00	6.2	1.00	8.00	9.0	1.48	01	
V0214		7.00	6.2	1.32	7.60	3.5	3.25X	01	
V0218		6.45	-2.1	.80	7.20	-1.9	.49	01	
V0220	*	5.55	-15.8	1.75	6.30	-14.2	3.01X	01	
V0221		6.30	-4.4	.40	7.30	-.6	.85	01	
V0238		7.45	13.0	3.57X	8.15	11.0	.49	01	
V0243		6.15	-6.7	1.20	6.70	-8.7	1.48	01	
V0246		6.45	-2.1	.00	7.15	-2.6	.00	01	
		6.59	* GR. MEAN *		7.34				3 TEST DETERMINATIONS
		.40	* SD MEANS *		.47				36 LABORATORIES IN GRAND MEANS
		.07	* AVER SDR *		.06				38 LABORATORIES REPORTING
		MINUTE	* UNIT *		MINUTE				


CURE TIME (50% MH)
MATERIAL Z71-Z72 6.59 MINUTE MATERIAL Z73-Z74 7.34 MINUTE
MATERIAL Z73-Z74
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
MATERIAL Z71-Z72

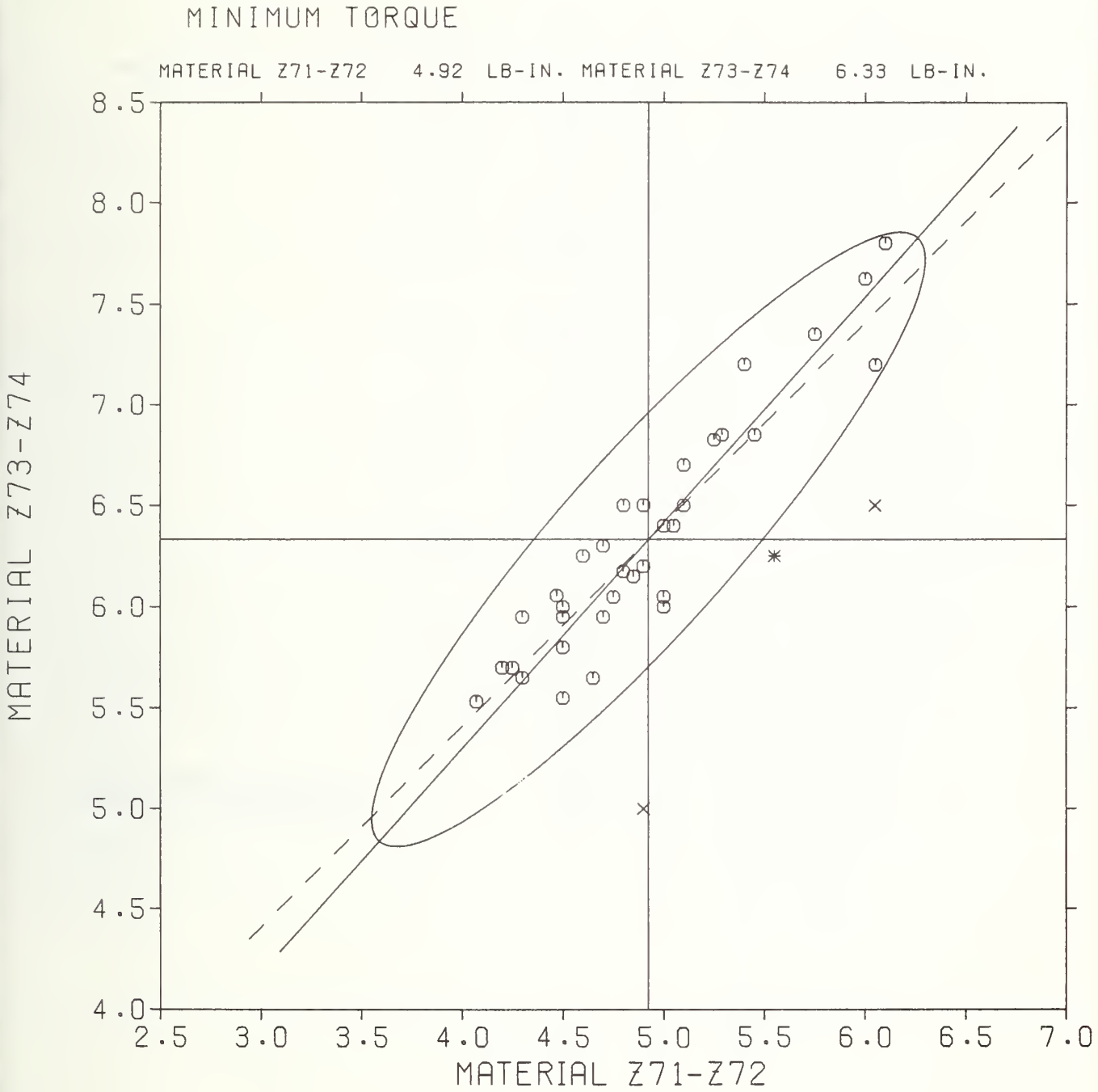
INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
CURE TIME (90% MH) - MINUTES

LAB CODE	F	MATERIAL Z71-Z72 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL Z73-Z74 SEE MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0077		10.22	1.8	1.94	15.92	8.7	1.63	01	
V0078		10.94	8.9	.00	15.69	7.1	.00	01	
V0079		10.50	4.5	4.45X	15.87	8.4	.00	01	
V0083		10.75	7.0	1.02	16.05	9.6	.22	01	
V0085		10.07	.3	2.81X	14.02	-4.2	.65	01	
V0090		10.49	4.4	.56	15.25	4.1	1.33	01	
V0092		9.72	-3.2	.81	14.50	-1.0	2.05	01	
V0093		10.25	2.1	.70	15.60	6.5	.50	01	
V0095		9.90	-1.4	.23	14.60	-.3	1.00	01	
V0100		10.00	-.4	.00	14.80	1.1	.00	01	
V0117		9.90	-1.4	1.71	14.57	-.5	1.63	01	
V0122		10.30	2.6	.70	15.50	5.8	.65	01	
V0128		9.55	-4.9	2.11	14.10	-3.7	1.56	01	
V0144	X	12.64	25.9	1.46	12.70	-13.3	1.05	01	
V0149		10.32	2.8	.82	15.07	2.9	.56	01	
V0150		10.90	8.5	1.04	14.85	1.4	1.76	01	
V0152		10.30	2.6	.23	14.75	.7	.00	01	
V0154		9.92	-1.2	.71	14.87	1.6	.71	01	
V0156		9.85	-1.9	.47	14.20	-3.0	.11	01	
V0158		9.15	-8.9	1.79	13.50	-7.8	1.29	01	
V0159		10.63	5.8	1.55	15.37	5.0	1.29	01	
V0161		9.65	-3.9	.87	13.85	-5.4	.80	01	
V0166		9.70	-3.4	.47	14.15	-3.4	.59	01	
V0169		9.80	-2.4	2.85X	14.35	-2.0	.80	01	
V0178	*	10.00	-.4	.00	13.10	-10.6	2.15X	01	
V0182		10.22	1.8	.35	14.77	.9	.61	01	
V0206		10.70	6.5	.94	15.20	3.8	1.29	01	
V0207	X	10.85	8.0	1.69	25.85	76.5	1.77	01	
V0208		10.22	1.8	1.92	14.15	-3.4	2.58X	01	
V0211		8.60	-14.4	.94	12.40	-15.3	1.03	01	
V0213		10.00	-.4	.00	15.00	2.4	.00	01	
V0214		10.50	4.5	1.26	15.02	2.6	1.11	01	
V0218		9.90	-1.4	.64	14.00	-4.4	.79	01	
V0220		8.65	-13.9	.94	12.85	-12.3	1.08	01	
V0221		9.45	-5.9	.70	14.80	1.1	.86	01	
V0238		11.35	13.0	2.11	16.65	13.7	1.37	01	
V0243		9.35	-6.9	.47	13.35	-8.8	.75	01	
V0246		9.80	-2.4	.00	14.50	-1.0	.00	01	
		10.04	* GR. MEAN *		14.65				3 TEST DETERMINATIONS
		.59	* SD MEANS *		.92				36 LABORATORIES IN GRAND MEANS
		.12	* AVER SDR *		.13				38 LABORATORIES REPORTING
		MINUTE	* UNIT *		MINUTE				

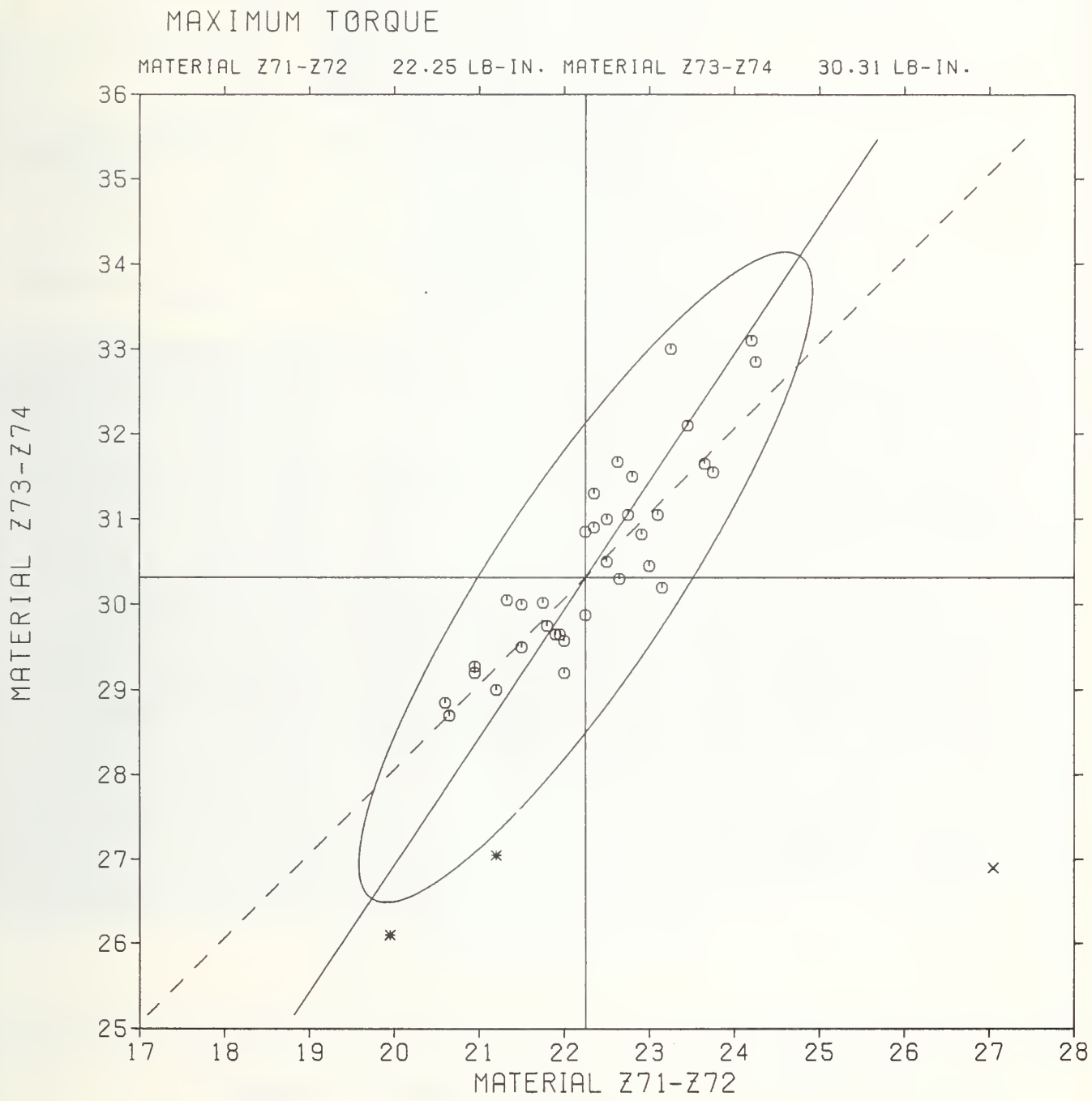

CURE TIME (90% MH)
MATERIAL Z71-Z72 10.04 MINUTE MATERIAL Z73-Z74 14.65 MINUTE
MATERIAL Z73-Z74
MATERIAL Z71-Z72
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0
12.5
13.0
13.5

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
MINIMUM TORQUE - POUND-INCHES

LAB CODE	F	MATERIAL Z71-Z72 COMMERCIAL TIRE TREAD MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MATERIAL Z73-Z74 SBR MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0077	*	5.55	.6271	12.7	2.04	6.25	.7062	-1.3	.86	01	
V0078		5.25	.5932	6.6	.00	6.82	.7712	7.8	.00	01	
V0079		4.90	.5537	-.5	1.30	6.50	.7344	2.7	.00	01	
V0083		5.00	.5649	1.5	.37	6.40	.7231	1.1	.34	01	
V0085		4.07	.4600	-17.3	.57	5.53	.6250	-12.6	.30	40	ORIGINAL IN NEWTON-METER
V0090		4.50	.5085	-8.6	.19	6.00	.6779	-5.2	2.06X	01	
V0092		4.70	.5311	-4.5	.74	5.95	.6723	-6.0	.34	01	
V0093		5.10	.5762	3.6	1.85	6.50	.7344	2.7	.60	01	
V0095		4.60	.5198	-6.6	.74	6.25	.7062	-1.3	1.82	01	
V0100		4.70	.5311	-4.5	.00	6.30	.7118	-.5	.00	01	
V0117	X	9.05	1.0226	83.8	1.11	12.20	1.3785	92.7	1.82	01	
V0122		5.00	.5649	1.5	.00	6.00	.6779	-5.2	.00	01	
V0128	X	6.05	.6836	22.9	3.68X	6.50	.7344	2.7	.34	01	
V0144	X	4.90	.5537	-.5	3.24X	5.00	.5649	-21.0	2.49X	01	
V0145		4.80	.5424	-2.5	.99	6.17	.6977	-2.5	1.30	01	
V0150		4.50	.5085	-8.6	.00	5.55	.6271	-12.3	1.37	01	
V0152		4.25	.4802	-13.7	.37	5.70	.6440	-10.0	.00	01	
V0154		4.30	.4855	-12.7	.74	5.95	.6723	-6.0	.94	01	
V0156		5.00	.5649	1.5	.37	6.05	.6836	-4.4	1.03	01	
V0158		4.80	.5424	-2.5	2.89X	6.50	.7344	2.7	1.03	01	
V0159		4.90	.5537	-.5	3.70X	6.20	.7005	-2.1	1.60	01	
V0161		4.75	.5367	-3.5	.64	6.05	.6836	-4.4	1.03	01	
V0166		4.50	.5085	-8.6	.00	5.95	.6723	-6.0	.34	01	
V0169		5.05	.5706	2.6	.74	6.40	.7231	1.1	1.82	01	
V0178		6.00	.6779	21.9	1.67	7.62	.8615	20.4	.00	01	
V0182		6.10	.6892	23.9	1.35	7.80	.8813	23.2	.34	01	
V0206		4.20	.4746	-14.7	.00	5.70	.6440	-10.0	.00	01	
V0207		6.05	.6836	22.9	2.67X	7.20	.8135	13.7	2.63X	01	
V0208		4.47	.5051	-9.2	.00	6.05	.6842	-4.4	.65	01	
V0211		4.30	.4859	-12.7	.74	5.65	.6384	-10.8	1.14	01	
V0213		5.29	.5977	7.4	3.94X	6.85	.7740	8.2	1.03	01	
V0214		4.65	.5254	-5.6	2.70X	5.65	.6384	-10.8	1.82	01	
V0218		4.85	.5480	-1.5	1.62	6.15	.6949	-2.9	1.25	01	
V0220		5.45	.6158	10.7	1.38	6.85	.7740	8.2	1.25	01	
V0221		5.40	.6101	9.7	.64	7.20	.8135	13.7	.69	01	
V0238		5.75	.6497	16.8	1.85	7.35	.8305	16.1	1.50	01	
V0243		5.10	.5762	3.6	1.11	6.70	.7570	5.8	.60	01	
V0246		4.50	.5085	-8.6	.00	5.80	.6553	-8.4	.00	01	
		4.92	.5563	* GR. MEAN *		6.33	.7154				3 TEST DETERMINATIONS
		.53	.0597	* SD MEANS *		.58	.0661				35 LABORATORIES IN GRAND MEANS
		.08	.0088	* AVER SDR *		.08	.0095				38 LABORATORIES REPORTING
		LB-IN.	N-M	* UNIT *		LB-IN.	N-M				


MINIMUM TORQUE
MATERIAL Z71-Z72 4.92 LB-IN. MATERIAL Z73-Z74 6.33 LB-IN.
MATERIAL Z73-Z74
MATERIAL Z71-Z72
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0

LAB CODE	F	MATERIAL Z71-Z72 COMMERCIAL TIRE TREAD MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MATERIAL Z73-Z74 SER MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0077		22.25	2.5140	.0	1.93	29.87	3.3756	-1.4	1.17	01	
V0078		22.62	2.5564	1.7	.00	31.67	3.5790	4.5	.00	01	
V0079		23.25	2.6270	4.5	2.68X	33.00	3.7287	8.9	1.17	01	
V0083		22.75	2.5705	2.3	2.46X	31.05	3.5083	2.4	1.17	01	
V0085		21.33	2.4101	-4.1	.50	30.05	3.3951	-.9	.77	40	ORIGINAL IN NEWTON-METER
V0090		22.00	2.4856	-1.1	.11	29.57	3.3417	-2.4	.23	01	
V0092		23.45	2.6496	5.4	.59	32.10	3.6270	5.9	.23	01	
V0093		22.50	2.5423	1.1	1.20	30.50	3.4462	.6	1.17	01	
V0095	*	21.20	2.3954	-4.7	.80	27.05	3.0564	-10.8	1.24	01	
V0100		22.80	2.5762	2.5	.00	31.50	3.5592	3.9	.00	01	
V0117	X	43.95	4.9659	97.5	.86	61.60	6.9602	99.9	4.02X	01	
V0122		23.00	2.5988	3.4	.64	30.45	3.4405	.4	.70	01	
V0128		21.90	2.4745	-1.6	.96	29.65	3.3502	-2.2	1.89	01	
V0144	X	27.05	3.0564	21.6	1.00	26.90	3.0394	-11.3	2.92X	01	
V0149		21.75	2.4575	-2.2	.89	30.02	3.3925	-1.0	.35	01	
V0150	*	19.95	2.2542	-10.3	.80	26.10	2.9490	-13.9	.47	01	
V0152		21.20	2.3954	-4.7	.00	29.00	3.2767	-4.3	.00	01	
V0154		22.25	2.5140	.0	.21	30.85	3.4857	1.8	.94	01	
V0156		22.00	2.4858	-1.1	.59	29.20	3.2993	-3.7	.47	01	
V0158		21.80	2.4632	-2.0	4.66X	29.75	3.3615	-1.9	.00	01	
V0159		21.95	2.4801	-1.3	1.62	29.65	3.3502	-2.2	1.40	01	
V0161		20.95	2.3671	-5.8	.99	29.20	3.2993	-3.7	1.71	01	
V0166		20.60	2.3276	-7.4	.00	28.85	3.2598	-4.8	.70	01	
V0169		24.20	2.7344	8.8	2.18	33.10	3.7400	9.2	.85	01	
V0178		24.25	2.7400	9.0	1.07	32.85	3.7117	8.4	1.72	01	
V0182		23.65	2.6722	6.3	.43	31.65	3.5761	4.4	.70	01	
V0206		20.65	2.3332	-7.2	.00	28.70	3.2428	-5.3	.00	01	
V0207		23.10	2.6101	3.8	1.91	31.05	3.5083	2.4	1.25	01	
V0208		22.91	2.5886	3.0	1.20	30.82	3.4824	1.7	2.17X	01	
V0211		20.95	2.3671	-5.8	.21	29.27	3.3078	-3.4	.71	01	
V0213		21.50	2.4293	-3.4	2.15	30.00	3.3897	-1.0	.00	01	
V0214		22.65	2.5592	1.8	1.15	30.30	3.4236	-.0	1.31	01	
V0218		22.35	2.5253	.5	.57	31.30	3.5366	3.3	.70	01	
V0220		22.50	2.5423	1.1	6.87X	31.00	3.5027	2.3	1.77	01	
V0221		23.75	2.6835	6.7	.43	31.55	3.5648	4.1	.85	01	
V0238		23.15	2.6157	4.0	1.64	30.20	3.4123	-.4	1.40	01	
V0243		22.35	2.5253	.5	1.20	30.90	3.4914	1.9	.94	01	
V0246		21.50	2.4293	-3.4	.00	29.50	3.3332	-2.7	.00	01	
		22.25	2.5135	* GR. MEAN *		30.31	3.4251				3 TEST DETERMINATIONS
		1.03	.1160	* SD MEANS *		1.47	.1665				36 LABORATORIES IN GRAND MEANS
		.13	.0152	* AVER SDR *		.12	.0139				38 LABORATORIES REPORTING
		LB-IN.	N-M	* UNIT *		LB-IN.	N-M				


MAXIMUM TORQUE
MATERIAL Z71-Z72 22.25 LB-IN. MATERIAL Z73-Z74 30.31 LB-IN.
MATERIAL Z73-Z74
MATERIAL Z71-Z72
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Collaborative Reference Programs provide participating laboratories with the means for checking periodically the level and uniformity of their testing in comparison with that of other participating laboratories. An important by-product of the programs is the provision of realistic pictures of the state of the testing art. This is one of the periodic reports showing averages for each participant, within and between laboratory variability, and other information for participants and standards committees.

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